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# *The* HIGH SCHOOL JOURNAL

School Buildings

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# *The* HIGH SCHOOL JOURNAL

SAMUEL M. HOLTON, *Editor*
Professor of Education, University of North Carolina

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IN THIS ISSUE

A Decade of Secondary School Plant Planning
*George W. Holmes, III* 130

Citizens' Participation in School Plant Planning
*Arnold C. Tjomsland* 135

The School-within-School Concept
*E. W. Rushton and John P. Leahy* 138

Prediction of School Plant Costs.....*William P. McLure* 142

Electric Resistance Heating for Schools.....*Henry Wright* 148

The Modern Secondary School Site.....*William J. Wynn* 154

THE CONTENTS OF THIS HIGH SCHOOL JOURNAL ARE LISTED IN "EDUCATION INDEX"

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# A Decade of Secondary School Plant Planning

GEORGE W. HOLMES, III
*Associate Professor of Education, University of Virginia*

THE decade of the 1950's brought more change in secondary school plants than any previous two or three decades in the history of American Public Education. When the last school plant issue of *The High School Journal* was published in 1950, school administrators and school boards were facing the problem of school plant facilities for the tidal wave of "war babies' which was about to roll into the elementary schools. For the first few years of the decade the major emphasis was upon elementary school plants and results in that field were little short of startling. During this period secondary school plants tended to be rather faithful replicas of those designed in the 20's and 30's dressed up with glass block, glazed tile and fluorescent lighting. Nevertheless, there were many bright spots in the picture. It was this period which produced Myers Park High School at Charlotte, North Carolina, Norman High School at Norman, Oklahoma, Newton High School at Newton, New Jersey and others scattered throughout the country.

As elementary school enrollments continued to grow community after community became aware of the fact that they either had or would have problems in adequately housing secondary school pupils. A growing realization that modern high schools were different from the college preparatory institutions of grandfather's day heightened interest in the problem. Rising costs and unrealistic limitations on borrowing complicated the picture. Well meaning but uninformed commercial interests flooded the country with pamphlets and brochures extolling the virtues of warehouses and storage buildings as the setting for education. A nationally known star of television and radio with a sincere interest in education got into the act by suggesting that certain prefabricated metal structures might solve the problem for many localities. This situation was indeed a challenge of the decade.

Fortunately for the future of this nation, school plants such as those named earlier were rising above the confusion. Architects and educators searched out and found those extraordinary examples of planning and design. They visited, studied and conducted tours for school board members. Research projects in the area of

human comfort and safety, new building materials and new construction methods were carried out. At the same time, individuals and groups were studying with new-found interest the adolescent and his educational, personal and social needs.

Interest in the problems at hand and the problem solving approach resulted in many advances. Secondary education was scrutinized and examined as never before. The educational needs of individual communities were surveyed through the cooperative efforts of professionals and laymen. The concept of the comprehensive high school grew by leaps and bounds. Those who studied invariably seemed to conclude that the educational program should be planned first and the plant then should be planned to house the program. The idea of throwing up a building as quickly as possible and then fitting the program to the plant disappeared rapidly. Educators and architects learned to communicate and to work as members of a team. The educational consultant came upon the scene as a member of the planning team. The development of cooperative procedures pave the way for lay participation in all but the most technical aspects of school plant planning. The advice and opinions of pupils, teachers and other school employees were sought actively and applied constructively. Those who were to use the new plants saw them develop step by step. The use of the new building for improved instruction was the subject of numerous faculty meetings months before the doors opened. In essence the plant became a teaching tool, an aid to instruction. Shelter from the elements no longer was the major reason for the building's existence. It was during this period someone said, "The least a school building can do is not get in the way of good teaching." It was not long before the passive plant which stayed out of the way of the program was replaced by the plant which actually encouraged good teaching. As a community monument, the building soon failed to compete with the Grecian columns and the Georgian cornices of past generations. The educational program became the true monument to wide-awake communities, thinking school boards, dedicated educators and creative architects.

No single building type completely dominated secondary school plant planning during the period under discussion. The major trend was one of designing plants to fit the needs of individual communities. The physically decentralized plan seems to have been most popular, and yet, in some localities the trend was toward compactness with the loft plan coming into its own as a school building type. No matter what the final form of the building,

it is safe to say that never before was so much thought given to the educational planning.

School sites grew in size. Sites of twenty-five to thirty acres were common. Sites of fifty acres and more were not rare. Growth in the size of sites was related to several factors. First, educators, architects and laymen came to the realization that the school plant includes more than a building—that the land surrounding the building can and should be just as much a part of the plant as the building itself. The use of land in the educational program certainly was a major factor. Understanding of the fact that amortized over its useful life land is the least expensive part of a school plant also helped increase the size of sites. The physical decentralization of plants required more land. Increasing use of automobiles by secondary school students made larger parking lots mandatory. Joint use of sites by school and community called for larger sites but also helped to avoid the duplication of recreational facilities within the community. Where these factors were considered along with the need for land for future growth larger sites were inevitable.

One of the great discoveries of the period was that in schools bigness is not necessarily synonymous with the highest educational quality. Many came to believe that when a high school grows larger than twelve to fifteen hundred pupils more is lost than is gained. Others went so far as to say that even a school of twelve hundred is too large for the individual instruction, guidance and attention adolescents need. This was a major reason for trend towards the decentralized plant in many communities. The campus plan and the little school or school-within-a-school organization were attempts to take the "sting" out of mass education.

As a general rule the first campus plans simply made possible a physical decentralization of the program. Instead of massive structures of classrooms piled upon classrooms, those campus plans housed one or two subject matter departments in each of several small buildings. Thus, the great mass of building and student body were broken down and spread out over several acres. Possibly some of the earlier campus plans were decentralized to the extent that sheer distance became a problem for both pupils and staff.

The organization of a large high school on the basis of manageable units is not a new idea. Nevertheless, the expression of this idea in terms of the school-within-a-school certainly was one of the most obvious developments of the decade. It has found physical expression in many different types of school plants. Yet, emphasis

always is upon the individual pupil and his program of instruction. Here is but one example of the way plants were designed to foster programs.

Post World War II technological advances were reflected in the school plants of the 1950's. New construction methods and new materials came into being. According to the manufacturer's advertisements many near perfect solutions to school plant problems such as lighting, heating, ventilating and communicating were found. Fortunately, each succeeding year brought even better solutions. Flexibility, convertibility and expansibility became watchwords. The stock plan virtually disappeared from the school plant scene. Even in school districts with continuous building programs the same set of plans seldom was used for two buildings. Advances came so fast that the possibilities for improvement were too obvious to repeat yesterday's solution.

It is interesting to speculate that limited budgets contributed to school plant improvement. Ideally plant needs are determined first and then a budget is made which will meet those needs. Ideal or not, the truth of the matter is that it simply was not done that way in a great many instances. Instead, the financial picture was studied and it was determined that a given amount of money would be spent on the new plant. Often the amount of money allocated fell short of that required for "complete facilities." As a result the term "complete facilities" came in for much study. For example, to many the idea of a high school without an auditorium was unthinkable. Past experience with the combination auditorium-gymnasium made that type of facility less than desirable. Study often revealed that a large auditorium seating the entire student body was used as little as two to five hours per week. Further study led to the conclusion that there were only a limited number of times during the year when it was necessary to bring the entire student body together at one place. Many concluded that for these three or four occasions the gymnasium or the out-of-doors could serve quite adequately. This led to the planning of a little theater or small auditorium which would accommodate the youngsters from one or two grades at a time. This facility often was planned for large group instruction, too. Thus, making possible a greater degree of utilization than ever had been dreamed of for the typical high school auditorium. O course, such a facility could not serve community-wide functions but it did make an excellent meeting place for community groups. Dozens of other examples could be given but they would serve only to point out that highly specialized

space gave way to more generalized space adaptable to many different uses. Of course, limited funds did not really create improvements. Tight budgets made planners think. Thinking created better solutions. Who knows what would have taken place if the same kind of thinking had occurred and budgets had been unlimited?

Space has permitted only the briefest of looks at the school plant developments of the 1950's. The 1960's are another story. What of educational TV? Teaching machines or programmed learning? Higher college entrance requirements? Automation? Increasing population? Higher taxes? Etc., etc.? No one knows the answer except that if the trends of the past decade are followed there will be better solutions than man has yet dreamed of.

# Citizens' Participation in School Plant Planning

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THOUGHTFUL men and women are asking for a basic strengthening of our educational system in ever increasing numbers. This is not a new phenomenon. The History of American Education indicates this questioning has developed concurrently with major changes in the economic and social life of the members of American Society. School buildings are built to house and educational program and therefore it is mandatory that changes desired by the citizens in the offering of the school should be spelled out very clearly before an architect begins to work on the drawing board.

Without belaboring the point, it seems reasonable to accept the fact that the United States has been enjoying, or tolerating depending on your political point of view, rather substantial social and economic changes since the end of the Second World War. Of all the changes experienced, the rapid expansion of knowledge may well be the most significant for the public schools and educational leadership. More and more a general awareness seems to be developing that even the most brilliant of men cannot be highly proficient in more than one narrow field of specialization. This fact alone suggests careful scrutiny might profitably be given to both the aims of education and the methods by which these aims can be accomplished. If aims and objectives change it might be concluded that content will change; with content change, teaching activities change and hence the program to be housed changes.

If it is accepted that curriculum change is inevitable, like death and taxes, because of fundamental changes in how people live and work, it becomes essential that a rationale be established to identify desired change and to project the educational program into the future. Projection into the future becomes necessary when it is recognized that school buildings are built to last one-half century or more.

In the development of a rationale for evaluating change, it appears that some decisions will have to be reached concerning the role of education in a changing society. Shall the schools lead or shall they follow the great onward sweep of change? Sound arguments can be advanced, for and against, the school and its responsi-

bility for moving society forward. On the other hand, even the most skillful debater finds himself in a rather untenable position trying to defend the proposition that the school system should be content to follow behind the main stream of political, social, economic, and philosophical thought.

Some serious students of education argue that the schools have not kept abreast of these main streams of change and as a result an increased concern for public education is being manifested. Perhaps the Admiral, his head only inches above the conning tower of his submarine, has commanded such a warm reception from the press and other communications media because these agencies, skilled in ferreting out news, have sensed the unrest among the public and have decided his utterances are news-worthy. The volume of noise created by the self-styled critic of education may not be a very solid measure on which to gauge the need for change, in fact, some recent research indicates the opposite may be true.

Three unpublished Doctor of Philosophy dissertations form the basis for a study in educational administration which indicates,

". . . vocal critics of today's schools are somewhat less than representative of the public as a whole. Whereas the vocal critics seem to be clamoring for greater attention to the intellectual aspects of education, the general public seems to be more concerned with practical preparation for adult life. . ."[1]

The Study indicated further,

"Without exception, the task elements which were perceived to be more important by the lay public than by educators were non-intellectual items."[2]

Where then does the educator, faced with the task of planning a new school turn for a rationale if he isn't justified in relying on the critics and if his own judgment is clouded with prejudice and some lack of insight?

Two studies undertaken by Venn and Peterson at Washington State University indicate there does exist a stable source to which the school planner can turn. In 1948 Venn found that fifty-nine per cent of seventeen hundred and twenty-eight patrons living in a school district agreed,

"The main function of the public school is to develop all aspects of the individual."[3]

In 1958 Peterson working in the same community using the same public opinion questionnaire but forced to limit the study to a

[1] Studies in Educational Administration, *The Task of Public Education*, p. 48. Midwest Administration Center, University of Chicago, 1960.
[2] Ibid, p. 47.
[3] Grant Venn, *The Development of a Long Range Educational Plan in Bellevue, Washington*, Unpublished Doctoral Dissertation, Pullman, Wash., Washington State University, 1952.

ten per cent sample because the school population had grown from 803 students to 8900 during the interim, found that fifty-three per cent of the people still held to the concept that all aspects of the individual must be developed.[4]

When it is recognized that the community studied was a bedroom area with one of the highest per capita incomes in the state made up primarily of professional people and the upper middle income group, the findings became more significant. The fact that after ten years of active criticism of the school the people still held to their original concept of the functions of public education indicates that here is a source or a group to which school planners may turn if they are to find valid aims for education and if they are to make valid projections into the future about the emerging program of education.

Books and countless articles in periodicals have described how a school plant planner works with lay groups. Obviously this short paper cannot attempt to describe in detail how to involve lay people in school plant planning. Perhaps the best that can be done is to suggest that school planners *must make every effort to establish communication with lay groups and then they must listen to what they hear and then they may well devise an action pattern that compliments what they have heard.*

The writer recognizes that he might be justly criticized for failing to indicate that he accepts the fact that school leaders must serve a leadership function in the area of their competence. This is not his intent. Communication indicates a two way movement of information. A long period spent in observing school leaders at work with their communities has convinced him that once the lines of communication are established it is natural for information and ideas to flow both ways. *With some deliberate design on the part of the educational leader his knowledge of what is important in education becomes a part of the understanding and desire of lay people as to what constitutes education that is rich enough in learnings and potent enough in value patterns to be adequate for the years ahead.*

[4] Delbert G. Peterson, *The History and Development of The Long Range Plan in The Bellevue School District*, Unpublished Doctoral Dissertation, Pullman, Wash., Washington State University, 1959.

# The School-within-School Concept

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AND
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DREAMING and school plant planning seem in some ways to be miles apart. One has the ethereal quality of never-never-land, the other is literally bound down to the harsh facts of concrete reality. Yet, no school plant plan worth its salt is ever produced without some dreaming, some vision of the best that might ever be, of the hope that may become a reality. In some ways the school-within-a-school concept has more of the dream-to-come-true quality than many other such ideas.

Nostalgia carries many of us back to the earlier days of American public education in the little school where everyone knew everyone else. In those days the student was a person that mattered. Education was a serious business that was touched, shaped, and formed by a human quality—a personal touch that seems lost in many of our schools today.

But practical consideration of changing conditions points out to us that the larger school, where students come from all kinds of neighborhoods, is advantageous for education also. In some respects it is more economical, seems to provide better facilities, may employ better qualified teachers, and according to some, offers a better education. Yet bigness has disadvantages along with advantages. For example, the school may become too big. Money may be wasted by duplication of poorer facilities. Is it ever possible to capitalize on the virtues of the big school and the virtues of the small school in one comprehensive high school? Could we get back to the personal quality, the human touch in education, and yet not deprive our children of modern, up-to-date buildings, of teachers adequately prepared for the services they perform? Is it possible? Let's dream a little.

What is it in any educational scheme that seems to make for the kind of success we all hope for? The answer is concern for the individual and his concern for his own education. Wherever these are present, education moves forward. We have heard for generations, even centuries, that all education is self-education. The stu-

dent must be vitally concerned in his own educational development. This is a key point, and we are proposing that our concern for the student will breed the concern for himself that we want. Here is the basic point of the entire school-within-a-school concept, the provision of a school plant designed to further by its very nature interest in the individual student and his interest in himself.

Think of a situation in which a student is part of a school, unit, or group of three to four hundred students with whom he will pursue his total high school career. The group is under the direction of fifteen to twenty teachers whom the student can come to know personally, professionally, and socially in a period of three to four years. House these people together in a building unit designed to further the small school feeling in a large school and you have the beginning of the school-within-a-school concept.

This is, to be sure, only the beginning. Bigness has its virtues too, as we know. Take two or three more of these units and make a big school of approximately twelve hundred pupils and you have the setting from which the good things of the big school may be gained. Visualize, if you will, all these units clustered together on one campus and you have the makings of the physical setting for a program to get at individual teaching and individual learning. At the same time you have the benefits of large group learning situations and large group activities so much enjoyed by adolescent groups.

The dream is this—to capture the best of both the large school and the small school with a view to giving to each child the best education that a community can provide. To do so, it is necessary that we build a building which has in its very design, in the heart of its plans, the quality of most appropriately serving the end envisaged. This, after all, is the very soul of good school plant planning, to catch in the buildings themselves the nature, the essence of quality education as seen by the builders and the community as they dream ahead and picture the best education for students.

How does this differ from what we expect from all schools? The answer is beautifully simple. It differs in that here a building is not provided just to make room for students and teachers, but rather the building is designed to meet as precisely as possible the real nature and needs of a program. The best plans of this type call for conventional classrooms and unconventional ones, rooms for small groups and areas suitable for large groups with flexibility the keynote over all.

But does it work? Can you really have your cake and eat it? How do you set up such a program without adding tremendously to costs both instructional and capital? The answers are yes, it can be done, and no, it shouldn't cost any more than the regular or standard school, assuming of course capable planning of the construction. The school system must provide the same number of classrooms, both regular and special, in the usual plant or in the school-within-a-school setup. Variations come in the number and location of buildings and in the amount and nature of the flexibility provided.

It goes without saying that the practical or operational implementation of such a facility calls for a new kind of thinking on the part of most people involved in the planning, programming and operation of the new type school. For example, the principal rather than being the direct in-line authority over all teachers is replaced by the head of the unit-school or small school. That is, the teacher now is one of a small group on the faculty under a unit head who is in turn under the direct control of the principal. It is important, however, that the unit head not be considered to be an assistant principal but rather the head of a small school of perhaps four hundred students with fifteen to twenty teachers (number, of courses, depends on definite plans locally adopted). His position is a different one, a new one. Strong efforts must be made to establish the position in the minds of the teachers, the students, and the community. The principal becomes the leader of an administrative and supervisory team made up of himself and the three or four heads of the small schools. Further, it would seem imperative that this team function as a team of responsible people rather than as a group of assistants to one person who makes all decisions.

From the student standpoint life becomes a simpler, less factory-like experience. He is placed in a unit as a first-year student and stays with that unit throughout his high school career. He may, and probably should, have the same home-room teacher throughout. He will have his general education courses, that is, English, history, mathematics, and other common requirements taught to him within this unit. Some subjects will, however, be scheduled to include students from other unit schools. The administration will have to make its own decisions as to how few or how many inter-unit classes will be held. There will also be need for scheduling that is flexible enough to allow for many of the advanced ideas of the Trump Plan or other attempts to increase staff utilization and provide the best quality of education conceivable in each local setting.

Guidance becomes an integral part of such a program of action. Closer contact with each student should cut down on problem cases and discipline difficulties. Personnel who normally spend hours in counseling may now be used to educate classroom and homeroom teachers in the latest guidance techniques and are free to conduct and make the best use of total-school and unit-school testing programs. The separate staff for guidance so common in many schools is almost coerced into doing the things guidance personnel have always felt were the key aspects of their jobs. This should help the school to provide the best immediate guidance for the student as the need arises in the homeroom and in the daily classroom activities. It should free guidance staff members to do more significant work than typically is possible now.

If we envision the best for the younsters of our community, and if we want that best to be a reasonable compromise between our dreams, our hopes, the realities of money, space and other real problems, we should seriously consider such an idea as the school-within-a-school. Reviewing the concept again, let us recall that its essential idea is the individualizing of the total teaching-learning situation, the provision of a chance for each student to feel "here is where I hang my hat; here is where I belong." He is no longer a number, a thing indefinable even to himself, a non-person with whom no one is really concerned save for attendance purposes and other head-counting activities. This proposal gives a way to return to the better elements of the simpler educational situations of our American past, yet does not force us to pay more for the privilege.

Probably no one has yet discovered the ultimate school any more than we have built the ultimate road to peace, but the conviction remains that the school-within-a-school concept is a step ahead, a step forward toward a higher quality program of education than we previously thought possible. Nevertheless, it is no panacea, it does not promise a pot of gold or pie in the sky. It provides a new direction for building and for developing school programs that favor the individual over the mass. It promises to help the student separate himself from his peers and recognize his own individuality with its potentials for success.

While we think realistically of the problems of school building planning, constructing and financing, let us not forget then to dream dreams and perhaps project for our community a new educational image which might well include the major ideas of the school-within-a-school.

# Prediction of School Plant Costs

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THE two most common purposes of prediction are to estimate the cost of: (1) particular units or plants under consideration for construction at some specified date, and (2) the total number of units or plants needed in a school system, a state or the nation for a given date or period of time. Each of these is a special problem with its own demands for method of analysis, type of information and degree of precision.

## THE COST OF PARTICULAR PLANTS

The term *cost* is a concept of common usage which is synonymous with the amount of money spent for something. That is, cost and expenditure are ordinarily used to mean the price paid for an object. If a man purchases a hat for five dollars, he customarily defines the cost as the marked price at the time he receives the article. He does not include other costs such as the value of his time spent in selection, expense of driving to the shopping district and parking fees. If the hat of his choice requires cleaning three times a season instead of once for another one which he might have selected, he does not take this difference into account. He does not figure the additional cost of replacing the lower priced hat more often than a type of better quality. If he finances the hat through a loan rather than paying cash he does not count the interest payments. Thus, the cost of this item of clothing to the wearer is more than the price marked for sale.

So it is with a school plant. The initial price at the time of occupancy is the major part, though not the complete cost. The initial cost is the common base for which comparative data are most useful in prediction.

A brief outline of procedure for predicting the initial cost of a particular plant would be as follows:

1. Define the educational program to be served.
2. Estimate the size of school enrollment to be accommodated.
3. Estimate the quality of various types of space to be included in buildings. Obtain the total estimated square footage of space.

4. Obtain estimates from local appraisers on cost of site and site development.
5. Obtain cost data on a sample of school plants as nearly comparable as the one being planned within the same region, expressed in cost per gross square foot of building area and cost per pupil.
6. Prepare a preliminary estimate of cost, indicating probable minimum and maximum figures.
7. Prepare detailed educational specifications.
8. Prepare architectural drawings.
9. Obtain final estimates from contractors' bids.

Any estimate short of the final stage is subject to wide fluctuation. Even contractors' bids commonly vary 10 per cent or more. There are so many variables that any preliminary estimate must be regarded as a rough figure.

To obtain reasonably valid preliminary estimates for a school plant, one must observe certain cautions. In the first place the estimation should be done by informed persons. A large amount of comparative data must be understood and properly interpreted. Comparability of the object predicted must be kept uppermost. Prediction is usually limited to the initial cost of construction of buildings. Administrative costs, sites and equipment are eliminated from estimates because of wide variations from one locale to another. However, as a starter the following percentages of the total initial capital cost may be helpful:

| | |
|---|---|
| Building Cost (Heating, Plumbing, Electrical Equipment) | 80 Per Cent |
| Administration Cost (Architectural Fees, Legal Services, Etc.) | 7 |
| Site | 6 |
| Equipment | 7 |
| Total Initial Cost of Plant | 100 Per Cent |

Preliminary estimates depend upon the use of unit costs such as: (1) cost per square foot of building area, and (2) cost per weighted pupil station. The components of these units contain variables which must be adjusted as nearly as possible to comparable standards. The principle ones are as follows:

1. Size of pupil enrollment.
2. Space requirements to serve comparable educational programs.

3. Design of building.
4. Quality of materials and workmanship.
5. Economic conditions (wage and price structure).
6. Geographic location.

As the size of the school population increases, the total amount of gross space per pupil needed for a comparable program decreases. Some adjustment for size is necessary or the data must be selected from schools where size is held constant. The relationship between size and cost has not been determined precisely for specified programs. Several studies since Dr. Paul Mort's original one[1] in 1923 have shown this relationship with reasonable accuracy for operating costs. A secondary school of about 700 pupils has repeatedly shown up as the size at which average per pupil operating costs no longer decrease as a result of further increase in enrollment. The writer has found evidence of an increase in this size limit to nearly 900 pupils in the state of Illinois from 1948 to 1958. These figures are based on *average practice* which is a compromise between the least and the most adequate situations.

The purpose of the American secondary school requires a complex program to serve a wide scope of human needs. Average practice represents a comprehensive program—but not comprehensive enough in some respects. My own conclusion is that a minimum secondary school population of 2,000 students in grades nine through twelve is necessary in a school system (not necessarily in one building) before the point of maximum economy in capital as well as operating costs is reached. By maximum economy, I mean the size at which no further savings in cost per unit of the school plant, or in operating cost of the program, can be expected with further increase in enrollment.

Cornell[2] recently estimated the relationship between high school size and building costs. On the basis of comparable standards which he assumed for various sizes, he concluded that a student population around 1,500 to 1,800 pupils is reached before true economies cease as a result of increased size.

The total amount of gross building area per pupil varies throughout the country from about seventy square feet per pupil to 150 square feet. These differences result from compromises with financial ability, design, breadth of program and perhaps efficiency in planning.

[1] Paul R. Mort. *The Measurement of Educational Need.* New York: Bureau of Publications, Teachers College, Columbia University, 1923.
[2] Francis G. Cornell. "High School Size and Building Costs," *The American School Board Journal.* January, 1947, p. 40-42.

The Educational Facilities Laboratories[3] recently reported the variations in median space (square feet per pupil) and median cost per square foot among ninety-two secondary schools distributed in different regions in the United States as follows:

| | Classrooms | Auxiliary Rooms | Service Areas | Medians of Totals |
|---|---|---|---|---|
| Northeast | 34 | 39 | 38 | 116 |
| Southeast | 27 | 24 | 15 | 75 |
| North Central | 38 | 37 | 45 | 117 |
| South Central | 26 | 31 | 38 | 78 |
| Western | 35 | 32 | 24 | 95 |

| | Total Building Cost Per Square Foot | Mechanical Cost |
|---|---|---|
| Northeast | $17.84 | $5.69 |
| South | 13.70 | 2.89 |
| Middle West | 14.91 | 4.34 |
| West | 14.64 | 4.60 |

These figures illustrate the problem of obtaining comparative data which reveal standards of design, cubic footage, per cent utilization and other things.

Economic conditions affect the cost. If the predictor uses reference data of preceding years he must make a price adjustment in time. For this purpose recognized indexes such as school building cost indexes of Engineering News Record, F. W. Dodge Corporation and bond prices of H. F. Clark are available. These indexes are average approximations by years and geographic regions to account for differences in costs.

## FUTURE PREDICTIONS

The planning in the past has been concerned largely with the concept of *a school* and not *a school system* to serve a given pupil population. As the purpose of secondary education continued to develop toward greater breadth and comprehensiveness this earlier notion of doing all things for all invidivuals in a single school (or attendance center) has become less and less adequate. The minimum size of a normally distributed population for which the expanding program can be provided with reasonable economy and efficiency has increased, as I have estimated, to about 2,000 pupils in grades nine through twelve.

Today about three-fourths of secondary school youth live in urban centers or attend schools with 500 or more enrollment. Most

[3] Educational Facilities Laboratories. *The Cost of a Schoolhouse.* New York: Educational Facilities Laboratories, 1960, p. 66-68.

of these are in single systems; or they are in such close proximity to others that administrative arrangements to serve a minimum of 2,000 students are feasible. Among the remaining fourth, much consolidation of schools and school systems is a necessity before efficient planning and estimation of costs can be made. This does not mean that all schools or even school systems should necessarily have a minimum of 2,000 secondary school pupils. In sparsely settled areas, it may be more economical to operate medium size schools for the general subjects and consolidate specialized and more expensive subjects such as vocational education on a larger regional basis for grades eleven and twelve. The point is that under the present distribution of population and means of transportation in the United States it is possible to devise organizational arrangements of instruction and plant facilities to accommodate minimum populations of 2,000 students except in the most sparse regions.

Somewhere between 125 and 150 square feet of gross building space per pupil are needed for a high quality program to serve a normally distributed student population of the minimum size for efficient operation. Wtih this size of school population all phases of a comprehensive program can be accommodated with efficient utilization of all types of space.

A word should be said about the total or true costs of school plants which are especially important with reference to future planning. True costs are the capital and operating expenses for the duration of the useful life of the plant. Accounting procedures do not distinguish precisely between these two types of expense. The relationship between capital and operating cost of a school plant is dependent upon such original factors as design, quality of materials and workmanship. The building with the lowest initial cost may over the long run become the most expensive one, with part of the original cost being deferred through payment of higher upkeep and maintenance.

The planning and projection of future plant costs will become increasingly difficult. The complexity of needs will require a shift from the individual school plant as an encompassing unit to the school system which includes schools as variable components. Greater concentration of population will make it necessary to estimate capital needs on a broader scale of population. Thus the basis of comparability of particular school plants will become restricted to selected samples with more prescription of characteristic than present methods demand.

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# Electric-Resistance Heating for Schools

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THE use of electricity for heating is essentially a question of economics. Electricity offers such a convenient means for distributing energy that its use for resistance heating would be universal if it did not involve increased operating costs.

There is, however, an important exception to this rule. Where central summer air conditioning is desired, the problem of distributing refrigerated air or water still exists. In such cases, unless numerous air-conditioners are used, the most important advantage of electric-resistance heating is cancelled. Some means will be needed for the *distribution* of "cold" in summer and will consequently be available for the distribution of heat in winter.*

The word "distribution" has not been stressed accidentally. Electric heat differs significantly from steam, "hydronic," and warm-air heat *only* in the method of getting it around a given building. Warm air heat distribution requires bulky ducts; steam and hot water require substantial pipes. Electricity moves through wires, the largest of which is likely to be considerably smaller than the smallest pipe used for heat distribution. And, whereas other fuels require the *manufacture* of heat within the building, the manufacture of electrical energy is taken care of by the electric utility.

As for the means of heat *delivery,* this is essentially the same with electric heat as with steam, hot water and warm air. Electric-resistance cable buried in plaster, for example, is a convenient means of warming surfaces like ceilings for panel heating. Electric baseboard heaters work very much like those "powered" by steam or hot water. Electric fan-coil heating units blow hot air that is indistinguishable from that supplied by their steam and hot-water counterparts.

Thus, in the school field, unless immediate or future air conditioning is at issue, the question of the feasibility of electric-resistance heating is almost purely economic—depending upon construction cost savings and the electric rate. Ordinarily, for electric heat to be

*In such cases, however, electricity can become the energy source for both heating and cooling—through the medium of one or another version of the heat pump.

practicable, elimination of the boiler room, chimney and expensive piping or duct-work, and savings in janitorial expenses must compensate for higher energy costs. The school field offers several special reasons why electric heating may prove economical. Schools are heated to the comfort point for only a comparatively small part of the time—even in winter. Schoolrooms are occupied in the middle of the day when temperatures are normally rising and solar gain is at a maximum. During such periods of occupancy, body heat, as well as heat from the lighting system, tend to compensate for building heat losses. The rest of the time—for fourteen or fifteen hours out of the twenty-four and two days out of seven, plus numerous holidays and vacations—school buildings need be kept only warm enough to prevent damage to equipment (usually about 50 or 55°F). Thus, fuel consumption tends to be less important in school heating than in continuous occupancy or less densely occupied buildings; and a higher cost per energy unit can be more readily counterbalanced by savings in construction cost and operating personnel.

In still another respect, electric school heating differs from other applications. The heating problem in schools is completely tied up with the problem of ventilation. For the reasons already mentioned, schoolrooms require ventilation-cooling much of the time—even in cold weather. The principal function of the heating system becomes one of warming the space to the comfort point immediately before occupancy—after which ventilation-cooling usually becomes necessary. One widely used means for accomplishing this double function is the unit ventilator—a fan-coil-type heating device with an outdoor-air inlet controlled by an automatic damper. Such units are available with electric heating elements, and constitute the best and simplest means for *delivering* electric heat—along with ventilation cooling—to the typical schoolroom.

### *Electric Heat Economics*

Given the electric unit ventilator as a means for heating classrooms (together with electric baseboards and fan-coil units in smaller spaces), the technical problems of electric heat resolve themselves into the factors of economic feasibility and the design of a suitable electric distribution and heating-control system. The economic feasibility of electric heat depends, first of all, on the overall rate structure applying in each specific instance—along with the rate per kilowatt hour—balanced against an estimation of the influence of construction cost savings on annual costs of ownership. In

most cases where electric heat is likely to be considered, a special flat rate (1.0 to 1.75¢ per KWH) is likely to be in force. Such a rate makes operating cost estimation very easy, since the estimated heat demand in Btu's per hour can be converted into kilowatts or dollars by simple multiplication. (With all types of electric heating equipment, precisely 3,413 Btu's are realized per KWH, and electric heat delivery is assumed to be 100% efficient).

The other form of electric rate structure likely to be encountered is the sliding-scale type, usually embodying electric demand clauses. Where the amount of current need is large, such rate structures may descend to a lower block rate far more favorable than the flat rate mentioned above. In very large schools, where most of the electric consumption will be at this rate, the sliding-scale rate structure can be extremely favorable. On the other hand, it may make electric heating of smaller schools (up to six classrooms) less favorable, since insufficient current will be used during most months so as to reach the low block rate.

In preparing operating cost estimates, the sliding-scale rate is a good deal more complicated to figure, because each month's electrical demand and consumption must be estimated and calculated, and charges for each of the twelve months added to estimate the total annual operating cost. A so-called off-peak rate has been set up by some utilities, usually to attract the water-heating load. These rate structures are ordinarily not intended for comfort heating, and when a utility finds the comfort-heat load attractive, it ordinarily creates a special comfort-heat rate, and the off-peak rate no longer applies. In the limited geographic area where an off-peak rate is available for school heating, preheating of the school building at five or six in the morning to a point somewhere above the comfort temperature provides a means for reducing operating cost.

### *Estimating "Cost of Ownership"*

Electric utilities interested in the heating load will, of course, be glad to supply data for estimating the relative cost of electric heating versus other fuels. With over 300 electrically-heated schools in operation, countrywide, there is a good deal of experience to go by. It cannot be too strongly stressed, however, that each case must be considered on its own merits by an engineer thoroughly familiar with both the electrical rate structure and the special characteristics of school heating.

Such estimates are made by calculating the heat loss of the structure and relating this calculation to the number of degree

days, building exposures, number of children per classroom, amount of evening occupancy and local electric rates. They can be checked by comparing a given case with an actual school of similar size in a similar climate—with necessary allowances for differences in use, electrical rates, etc.

Usually, the costs of electric heat for a projected school are estimated in comparison with the costs of the same school heated conventionally by gas or oil. The original cost of the building will ordinarily be lower if calculated for electric heat, because of the elimination of boilers and piping equipment; but operational costs will be higher, because of the greater cost of electric energy per Btu. This demands a careful analysis of the probable savings of space, interest charges on the lower original cost, elimination of custodial wages and insurance cost for nonexistent boiler equipment (usually made with the proponents of different fuels fighting every inch of the way).

Since a gallon fuel oil utilized at 70% efficiency will compensate for over 100,000 Btu's of heat loss—as compared with 3,413 Btu's per KWH for electricity—oil at 13 cents per gallon is still less than half the cost of electricity at 1 cent per KWH (100,000 divided by 13 equals 7,692 Btu per penny). Against this fact, proponents of electric school heating marshal a number of arguments. By the nature of its operation, an electric heating system uses fewer Btu's to accomplish the same classroom heating result. During practically all of the school day, when lights and the bodies of the occupants are supplying almost all or sometimes even more than the heat necessary to satisfy the thermostat, the resistance elements are off completely and use no current; but a central boiler will still be consuming fuel, even though the heat is not being distributed. Similarly at night: the electric heat is off except for a few on-periods necessary to maintain the low night setting, while the gas or oil boiler will still be consuming gas or oil to maintain water temperature even when supplying no heat. What this argument adds up to is that in the case of schools, the efficiency of conventional heating is not likely to reach the previously assumed 70%.

Second, the building design used in comparing the types of heating energy is usually a traditional plan not likely to be favorable for electric heating. There is probably little provision for insulation, small consideration of orientation, use of glass, heat-conserving structural materials, etc.

Thirdly, all the discussion of how to build a school for greater economy can be made irrelevant by a simple basic question: what is

best for the children and the educational process? The question of whether to design a cluster or a finger plan, to use full window walls of single glass or simply a strip of easily shaded double glazing is only secondarily a matter of economy. The argument of principle goes to the more efficient educational plant.

One educator, who has had experience with an electrically heated school, has declared, "Design a classroom to capitalize effectively and efficiently on modern basic educational trends and you have designed a room with all the prerequisites necessary for electric heat!" Dr. Hugo Beck, Superintendent of the Bayless School District, St. Louis, presents, in support of this statement, the trend toward the extended school year and the trend toward the greater use of audio-visual techniques in teaching.

Audio-visual techniques will reduce the importance of glass areas for light, for view, or for ventilation. A teacher should be able to present a film with a minimum of fuss, Dr. Beck declares.

Dr. Beck, presenting the economics behind his approval of electric heat, gives the following construction cost figures for the Bayless High School:

| | |
|---|---|
| Cost of electric heating system | $ 52,479 |
| Cost of conventional heating system comprising | 68,251 |
| Mechanical contract | 58,385 |
| Boiler room construction | 8,433 |
| Boiler room plumbing | 403 |
| Boiler room electrical work | 1,030 |
| Initial savings on construction | $15,772 |
| Total building cost, as of Jan. 24, 1958 | $530,850 |
| Conventional heating would be 12.85% of contract price | |
| Electric heating, 9.90%. | |

The Sparta Township High School, New Jersey, with 76,000 sq. ft. and 25 classrooms plus gymnasium, auditorium special rooms, offices, etc., was calculated to have saved $41,115 on initial costs with electric heat—$96,110 against $138,745 for an oil-fired system. Additional costs for oil system: brick stack, $4,200; boiler room $10,000. For electrical heating: extra insulation and double glazing, $15,720. Totals: $152,945 against $111,830.

Annual cost of ownership was estimated at $16,231 for oil, $15,670 for electricity.

| | *Oil-Fired* | *Electricity* |
|---|---|---|
| Fuel cost | $ 6,000 | |
| Electricity cost, incl. light and service | 6,121 | $15,670 |
| Principal repayment, extra, $41,115—20 yrs. | 2,050 | |
| Average interest @4½% on $4k, 115 | 970 | |
| Boiler insurance | 270 | |
| Building insurance savings | 20 | |
| Boiler maintenance | 500 | |
| Fuel heater operation | 300 | |
| Boiler feed water treatment, safety, cleanliness, probable increase in fuel costs | ? | |
| Total annual operating costs | $16,231 | $15,670 |

An economic analysis of the Northern Pike School, Monroeville, Pa., makes a double comparison—between the actual bid of the electrically heated school with good insulation and the same building if heated by gas, and the school heated electrically but without adequate insulation and similarly designed, but for gas.

With little insulation, the gas school cost $54,355 more than the electric school ($535,310 vs. $468,995), and its annual owning and operating cost came to $6,816 against $7,230 if heated electrically.

With $3,800 additional insulation, the gas-heated design would cost $55,155 more than the school as actually bid for electric heat ($524,110 vs. $469,755). But because of the insulation, annual operating and owning cost of electrical heat was brought below that of gas—$5,506 to $6,463.

The use of school buildings in summer for make-up, for enrichment, for recreation and for community activity calls for a relatively constant year-round temperature. A building prepared for resistance heating will have the insulation, the heat-gain and heat-loss characteristics and wiring that makes air feasible.

# The Modern Secondary School Site . . . Or Is It Sight?

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WILL the secondary school site which you are now exploring—with a view toward selection—be as inadequate in the year 2000 A.D. as the sites you are struggling to live with now, which were your heritage from 1920?

What criteria are available to your team of superintendent, board, city and county planners, architect, staff, and community, as you approach this critical site acquisition?

Should myopia afflict all those involved in the problem, at the same time, this restricted vision will limit them to:

a. Available land and its cost
b. Location in relation to distribution of secondary school age young people
c. Utility services such as water, sanitation facilities, electricity, and fuels
d. Hazards, and incompatibilities of the order of glue factories, stables, super-highways, and jet aircraft flight patterns

If you are a busy administrator, you can save time by restricting your selection to meet only the above requirements.

An inquiring mind might well consider these extensions of the button-shoe era approach.

*Question.* How large?

*Answer.* Very large! The educational program planned for the secondary school should be the chief determinant of the size of the real estate acquired.

We suggest that using forty acres as a point of departure, the prudent planners may well accommodate all the essential requirements of the curriculum now and tomorrow, as well as those inevitable and socially justifiable demands on the school campus from such outside sources as park and recreational folks, adult education needs, extended day and year trends, civil defense authorities, and local planning commissions, to mention only a fragmentary list.

In most areas of our nation the increase in land values has continuously outstripped the slow, upward pace of school building costs; thus frugality on the part of the decision-makers will dictate that to err on the side of "too little" is indefensible.

*Question.* How much should a district pay for a site?

*Answer.* Not much less than is usually expended in the community for such facilities as a first rate shopping center, country club, or bowling alley, unless these are decreed by the subtle (or perhaps not so subtle) power structure of the community to have a higher social value.

*Question.* What should be the physical characteristics of the site?

*Answer.* The site should be sufficiently varied to incorporate, if not all, a majority of the natural resources of the region within the bounds of the service area of the school. The hill can contribute as much as the plain. Dr. John Brainerd of Springfield College, is not alone in his thesis that, "A properly maintained view from an eminence, even a low one, can give students an improved perspective on their environment, be they studying astronomy, weather, or patterns of human culture."

When earth-moving equipment is introduced to the secondary school site, it should be for purposes of reinforcing or accenting varied topography—never to obliterate its features. Careful conservation of the site will militantly preserve marsh, grasslands, streams, eroded areas, rock outcroppings, stands of trees, as well as lakes, ponds, or puddles. Can we justify transporting our students long distances from the campus for study of what was once the natural setting of the school?

*Question.* What new educational or social phenomena should influence site selection?

*Answer.* Invariably larger areas are required than heretofore, to accommodate:

1. "The school within a school" and all of its implications for higher density site loadings, preserving a small school atmosphere by greater than traditional space between the elements
2. Expanding physical education facilities—the concept which if it hasn't emerged in your community—is evident everywhere else, that physical education is essential for all—not just the team engaged in interscholastic athletic programs

3. Extended community use for park and recreational activities for youth and adult
4. Outdoor education, "the school camp," and the summer school and/or camp for all ages

*Question.* When should we acquire a site?

*Answer.* In California, state funds are advanced to qualified districts for advance site purchases, on a seven year projection. This is felt by many to be too short range a projection. Most serious impediment to the program is the explosive increase in land values. From this experience and that in numerous other areas, it is evident that site selection horizons must be boldly extended.

*Question.* How do we implement, with security, the suggestions incorporated in this presentation?

*Answer.* As educational leaders in your respective communities, you are going to have to face up to the reality that the satisfaction of such basic psychological and emotional needs as are posed in your question cannot hope to be assumed as a fringe benefit of the position you now occupy. You must be prepared to have these met from home, family, and a few carefully cultivated loved ones, outside of the arena in which you have chosen to make your livelihood.

*Summary.*

The meat, gentlemen, in the modern secondary school site cocoanut, is:

1. Advance program analysis and planning is the overpowering consideration, as you begin the selection of a site
2. Most "bargain" sites preclude your ever getting an adequate secondary school program off the launching pad
3. Give some consideration to usurping space occupied by eagles, not just cows
4. Look ahead not less than twenty-five to fifty years. You might follow Satchel Paige's admonition to, "look back a little, too—something might be gaining on you."
5. Keep your site selection activity divorced from your aspirations to be chosen as the most popular man in your community.

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